

Clarification of the status of *Paraferreola* Šustera, 1912 as an available genus name in Pompilidae, and the identity of *Sphex ursus* Fabricius, 1793 in Mutillidae (Hymenoptera)

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Abstract

The usage of *Paraferreola* Šustera, 1912 since its proposal as a genus of spider wasps, but based on a misidentified type species (*Sphex ursus* Fabricius, 1793, actually a species of Mutillidae), shows that it continues to be applied (although infrequently) in Pompilidae, despite the proposal of new names (*Eoferreola* Arnold, 1935 and *Tea* Pate, 1946) for the equivalent generic concept. Application of Article 70.3.2 of the fourth edition of the International Code of Zoological Nomenclature permits correction of the erroneous type species designation to that originally intended (*Sphex rhombica* Christ, 1791), and thus the maintenance of *Paraferreola* as a valid genus in Pompilidae. Examination of the holotype specimen of *Sphex ursus* has shown it to be a senior synonym of *Mutilla vesta* Cresson, 1865 and its junior synonyms, for which the valid name must thus be *Dasymutilla ursus* (Fabricius, 1793), **comb. nov.**

Keywords

Dasymutilla vesta, *Eoferreola*, new combination, new synonymy, *Tea*

Introduction

The family attribution of the genus *Paraferreola* Šustera, 1912 has long been contentious. It was originally proposed for a group of spider wasps (Pompilidae), with *Sphex ursus* Fabricius, 1793 designated as the type species (Šustera 1912). However, examination of the type specimen of that species by various authors showed that it is not a pompilid, but instead is a male of Mutillidae, although its genus was then not determined. Consequently, Pate (1946) excluded *Paraferreola* from Pompilidae and proposed the use of a different name for the relevant pompilid taxon. Nevertheless, some authors have persisted in the use of *Paraferreola* in Pompilidae, considering that Šustera had misidentified his type species. The name *Paraferreola* has never been used as a valid name in Mutillidae.

Here we review the history and usage of the names involved and propose a solution that maintains *Paraferreola* as an available name in Pompilidae, and identifies *Sphex ursus* to species in Mutillidae.

Chronological history of applications of *ursus* and *Paraferreola*

In his treatment of the Piezata (= Hymenoptera) Fabricius (1793) included 92 species in the genus *Sphex* Linnaeus, 1758. Many were newly described, including, on p. 210:

“*Urfus*. 48. S.[phex] hirta atra abdominis segmento secundo ferrugineo, alis atris.

Habitat – – Muf. Dom. Lund. [locality unknown, specimen in collection of Niels Tønder Lund]

Statura & magnitudo praecedentis [S. viatica Linnaeus]. Corpus totum hirtum, atrum segmento abdominis secundo solo ferrugineo. Alae nigrae.”

The brief description refers to a hairy black wasp with only the second abdominal [metasomal] segment ferruginous and black wings, but from an unknown locality. At that time, Fabricius included many distantly related species in the genus *Sphex*. However, Fabricius (1798) established the new genus *Pompilus* Fabricius, 1798 to accommodate a group of species he considered very similar to *Sphex* itself, and included 37 species, most transferred from *Sphex*. The fifth species of *Pompilus* is *P. ursus*, accompanied by a description identical to the 1793 treatment, still with no indication of its place of origin. This entry was repeated in Fabricius’s (1804) work reviewing the Hymenoptera (14th under *Pompilus*). The concept that *S. ursus* is a member of the Pompilidae thus originated with Fabricius. This was confirmed by Dalla Torre (1897: 330) in his multi-volume catalogue of the Hymenoptera, where he recognized *Pompilus ursus* as a valid species (from central and southern Europe), but also suggested that *Sphex rhombica* Christ, 1791 might be a senior synonym; he placed *Pompilus coccineus* Fabricius, 1804 (female) as a junior synonym and also synonymized a few other pompilid species with it. Schulz (1906: 169), in his detailed commentary on Dalla

Torre's catalogue, suggested that *Pompilus amurensis* Motschulsky, 1860 might actually be "*ursus* F." or a relative, but made no further comment on *ursus*, and it is probable that he accepted Dalla Torre's concept of the species since he did not comment on the contradiction between Motschulsky's characterization of *P. amurensis* as "nitidus" (smooth) and Fabricius's "hirta" (hairy) for *S. ursus*.

The first contradiction to the placement of *ursus* in Pompilidae was provided by Nielsen (1907) who, in his treatment of the Pompilidae of Denmark, included the species "F.[erreola] coccinea Fabr. (nec *ursus* Fabr.*)" and a very brief explanatory footnote (p. 49) "(*) *P. ursus* Fabr. er efter Typeeksemplaret en Mutilla." implying that he had examined the type specimen and found that it was a *Mutilla* (used in a sense encompassing most members of the family Mutillidae, excluding *Myrmosa* Latreille, 1797). No further information was provided under the section on the Mutillidae, where only two species of *Mutilla* were included and *ursus* did not appear, implying that Nielsen did not consider it to be a Danish species.

Šustera (1912, 30 September) reviewed the Palaearctic genera of Pompilidae and proposed *Paraferreola* Šustera, 1912 as a 'new name' for "*Ferreola* Smith (Kohl, Costa, Tourn.) part., Rad., Ashm., nec. Lep[elletier de Saint-Fargeau 1845].", and he specified "Type: *Paraferreola ursus* F.". Šustera had evidently not seen Fabricius's type material, nor Nielsen's (1907) footnote, but merely relied on subsequent placement of *ursus* in *Pompilus* by Fabricius (1798, 1804), Dalla Torre (1897), and possibly Schultz (1906) (see above); he apparently accepted Dalla Torre's synonymies, and his description included characters of both sexes, but even those for males not agreeing with those of the type of *ursus* (see below). It is thus obvious that Šustera misidentified the type species.

Schulz (1912, mid November) critically reviewed the contributions of the classical Scandinavian authors to knowledge of the Hymenoptera, in particular through examination of all of their type specimens that he could trace. He reviewed all of the works of J.C. Fabricius and quoted the descriptions found in his last relevant work, the *Systema Piezatorum* (1804), evaluating synonymies where necessary. He noted that Fabricius's types were marked by a small, square, green label on the pin, so that they were identifiable as such with some confidence. He noted Nielsen's (1907) footnote, and also concluded, after repeatedly examining it, that the "type" of *Sphex ursus* in Copenhagen was a male mutillid and probably a species of *Myrmilla* Wesmael, 1851. Schulz noted that there were two additional male specimens of *ursus* in Fabricius's own collection then in Kiel (but presumably not marked as types), and provided a more detailed description than Fabricius had, in translation: "11 mm long, black and black (nowhere white) hairy. 1st abdominal segment red, likewise the 2nd (with the exception of its black end margin); 2nd abdominal segment with golden-yellow hairs above, black hairs below. The 1st not petiolate, but triangular or bell-shaped, with a longitudinal keel below. Compound eyes on the inner edge not emarginate." He was unable to suggest the species' distribution, except to state that he had not found it in André's [1899–1902] work on Palaearctic mutillids, nor in Bingham's [1897] "Fauna of British India".

Haupt (1927: 271, 308) cited Schulz's (1912) identification of the type of *ursus* as a "*Mutilla*", but claimed that Šustera's designation of *P. ursus* was understood to mean

P. rhombica (recognizing Šustera's misidentification, and probably accepting Dalla Torre's (1897) suggested 'synonymy'), and therefore Haupt specified "*Paraferreola rhombica* Christ" as the type species of *Paraferreola*. Haupt's interpretation was almost certainly correct, to judge from the species included in the genus by Šustera (the name *rhombica* does not appear in Šustera's paper, nor do the names of any of the other species synonymized with *ursus* by Dalla Torre); the original descriptions of *ursus* and *rhombica* are broadly similar, although differing in a few minor details, so such a misidentification is understandable, and seems to have been generally accepted. Arnold (1935) also gave *P. rhombica* Christ as the "genotype" of *Paraferreola* Šustera, and proposed a new monotypic subgenus, *Eoferreola* Arnold, 1935 with *Anoplius soleanus* Cameron, 1905 as "genotype", under *Paraferreola*.

Pate (1946) referred to Schulz's (1912) identification of *ursus* as probably a *Myrmilla*, and stated that *Paraferreola* was therefore referable to the Mutillidae; he proposed *Tea* Pate, 1946 as a "new subgenus" (of *Eoferreola*) for "*Paraferreola* Auctt. not of Šustera", with its type species as "*Sphex rhombica* Christ, 1791 [= *Eoferreola* (*Tea*) *rhombica* (Christ)]". Arnold (1948) recounted the situation, and emphasized that "*Paraferreola* Šustera, being a synonym for a genus of the Mutillidae as yet undetermined, cannot be sustained as a Pompilid genus", despite the fact that Šustera had misidentified its type species; he considered *Eoferreola* as a subgenus of *Tea* based on the fact that *Eoferreola* had been described as a subgenus of *Paraferreola*.

Wahis (1986) later designated *Tea* as a junior subjective synonym of *Eoferreola*, which meant that *Eoferreola* became equivalent to Šustera's original concept of *Paraferreola* (based on his misidentification). (The confusion in usages of *Tea* is illustrated in Table 1.) Nevertheless, although *Eoferreola* has more recently become the preferred name, several recent papers have still used *Paraferreola* for species of the genus (see Table 2), admittedly mostly in catalogues or lists, but some in non-taxonomic contexts. There are at least four pompilid species (including the type species of *Eoferreola*) that are still placed in *Paraferreola* according to the major online aggregator, the Catalogue of Life (Bánki et al. 2021, based on Kroupa and Schmid-Egger 2019, which unfortunately contains many errors according to Christian Schmid-Egger pers. comm.), but the listing of *Paraferreola* species includes neither *rhombica* nor *ursus*. The genus-group names *Paraferreola*, *Eoferreola* and *Tea* have thus all been used for related members of the Pompilidae over more than 100 years, including several recent treatments. However, Pagliano (2008), in a list of Hymenoptera genera and type species, listed *Paraferreola* (type species *Sphex ursus*) as an invalid genus equal to *Eoferreola* (type species *Anoplius soleana*), and *Tea* (type species *Sphex rhombica*) as a junior synonym of *Eoferreola*.

Despite the fact that various authors (see above) have pointed out that the type specimen of the nominal species *Sphex ursus*, designated as the type species of *Paraferreola* by Šustera, is a member of the Mutillidae, the name *Paraferreola* has never been used as a valid name in Mutillidae. It has either been overlooked, forgotten or perhaps even deliberately ignored, and does not appear in recent surveys of the genus-group names in Mutillidae (Lelej and Brothers 2008; Brothers, Lelej and Williams 2019) nor a checklist of mutillid species (Pagliano et al. 2020), which does not include *ursus* as a specific name either.

Table 1. Usages of *Tea* Pate, 1946.

Year	Name(s) used as valid	Notes	Reference
1946	<i>Eoferreola</i> Arnold subgenus <i>Tea</i> Pate: <i>E. (T.) rhombica</i> (Christ)	New name for “ <i>Paraferreola</i> Auctt., not of Sustera, 1913”	Pate (1946: 109)
1948	<i>Tea</i> Pate (genus): [<i>T.</i>] <i>melanostoma</i> Cam.; [<i>T.</i>] <i>spilopus</i> Cam. <i>Tea</i> subgenus <i>Eoferreola</i> Arnold: [<i>T. (E.)</i>] <i>soleana</i> Cam.	In discussion of validity of numerous proposals by Pate (1946)	Arnold (1948: 231)
1963	<i>Tea manticata</i> Pallas	Under Pompilinae in survey of fauna (Yugoslavia)	Wahis (1963: 194)
1965	<i>Tea</i> Pate 1946, subgenus <i>Eoferreola</i> Arnold 1935: <i>T. [(E.)] rhombica</i> (Christ 1791); <i>T. [(E.)] thoracica</i> (Rossi 1794); <i>T. [(E.)] manticata</i> (Pallas 1771); <i>T. [(E.)] erythraea</i> (Pallas 1773); <i>T. [(E.)] lichtensteini</i> (Tournier 1895)	Under Pompilidae Leach 1819, Pompilinae Ashmead 1900, Psammoderini Arnold 1935 in systematic survey of Pompiloidea (Central and Northern Europe)	Wolf (1965: 20)
1966	<i>Tea manticata</i> Pall.; <i>T. rhombica</i> Christ; <i>Tea</i> Pate, 1946, Subg. <i>Eoferreola</i> Arn., 1935 (<i>Paraferreola</i> auct.); <i>Tea</i> Pate (<i>Paraferreola</i> Sust.)	Under Psammoderini in list of pompilid species (Upper Austria) and key to pompilid genera (Europe)	Priesner (1966b: 191, 195, 202, 205)
1967	<i>Tea</i> : <i>T. anomala</i> Haupt; <i>T. manticata lichtensteini</i> Tourn.; <i>T. spec. aff. rhombica</i> Christ; <i>T. caucasica</i> Rad.; <i>T. syraensis</i>	Under Pompilinae in account of fauna (Turkey)	Priesner (1967: 56)
1968	<i>Tea</i> Pate, 1946, subgenus <i>Eoferreola</i> Arnold, 1935: <i>T. [(E.)] rhombica</i> Christ, 1791; <i>T. [(E.)] manticata manticata</i> Pallas, 1771; [<i>T. (E.)</i>] <i>manticata lichtensteini</i> Tourn.; [<i>T. (E.)</i>] <i>erythraea</i> Pall., 1773; [<i>T. (E.)</i>] <i>thoracica</i> Rossi, 1794	In review of taxonomy and faunistics of Pompilidae (Austria)	Priesner (1968: 169–171)
1970	<i>Tea (Eoferreola) rhombica</i> (Christ); <i>T. (E.) thoracica</i> (Rossi); <i>T. (E.) m. manticata</i> (Pallas); <i>T. (E.) manticata iberoturantica</i> ssp. nov.	Under Pompilinae Ashmead, Psammoderini Arnold in listing of specimens in museum collection (Italy)	Wolf (1970: 399)
1970	<i>Eoferreola (Tea) manticata manticata</i> (Pallas).	Under Pompilidae in review of fauna (Yugoslavia)	Wahis (1970: 719)
1972	<i>Eoferreola (Tea) filiantennata</i> sp. nov.	Under Pompilinae, Psammoderini in report on Pompilidae collected by expedition to Mongolia	Wolf and Moczar (1972: 243–244)
1973	<i>Eoferreola</i> Arnold 1935 Subgenus <i>Tea</i> Pate 1946 (= <i>Paraferreola</i> auct. nec Šustera 1913): <i>E. (T.) syraensis</i> Rad.; <i>E. (T.) anatolica</i> sp. n.; <i>E. (T.) schmidtii</i> sp. n.; <i>E. (T.) rhombica</i> ; <i>E. (T.) manticata manticata</i> Pall; <i>E. (T.) manticata lichtensteini</i> Tourn.	Under Pompilidae in paper describing recently collected new species (Turkey)	Priesner (1973: 109–110)

Table 2. Usages of *Paraferreola* Šustera, 1912 as a valid genus in Pompilidae (not exhaustive).

Year	Name(s) used as valid	Notes	Reference
1912	<i>Paraferreola</i> Šustera, 1912: <i>P. ursus</i> F.; <i>P. stygia</i> Costa; <i>P. caucasica</i> Rad.; <i>P. distincta</i> Sm.; <i>P. grandis</i> Rad.; <i>P. Hellmani</i> Ev.; <i>P. Lichtensteini</i> Tourn.; <i>P. manicata [sic]</i> Pall.; <i>P. micans</i> Rad.; <i>P. Komarowi</i> Rad.; <i>P. nigra</i> Rad.; <i>P. rossica</i> Rad.; <i>P. sirdariensis</i> Rad.; <i>P. syraensis</i> Rad.	Under Psammocharinae in review of pompilid genera (Palearctic); list of included species under description of new genus.	Šustera (1912: 201)
1922	<i>Paraferreola manicata [sic]</i> Pall.	In discussion under <i>Platyderes</i> Guérin in survey of aculeates (Balkans)	Šustera (1922: 60)
1927	<i>Paraferreola</i> Šust. 1913 [<i>sic</i>]: <i>P. grandis</i> Rad.; <i>P. syraensis</i> Rad.; <i>P. caucasica</i> Rad.; <i>P. hellmani [sic]</i> Ev.; <i>P. manticata</i> Pall.; <i>P. manticata</i> f. <i>mixta</i> Tourn.; <i>P. erythraea</i> Pall.; <i>P. rhombica</i> Christ.; <i>P. rhombica</i> f. <i>thoracica</i> Rossi.	Under Homonotinae in monograph of Psammocharidae (= Pompilidae) of middle, northern and eastern Europe	Haupt (1927: 271–282)
1930	<i>Paraferreola</i> Sust. 1913 [<i>sic</i>]: <i>P. erythraea</i> Pall.; <i>P. rhombica</i> Christ;	Under Homonotinae in monograph of Hymenoptera of northern and middle Europe.	Schmiedeknecht (1930: 624–625)
1930	<i>Paraferreola manticata</i> Pall.	In lists of insects illuminating zoogeography of a region (Poland)	Kinel and Noskiewicz (1930: 279, 285)
1933	<i>Paraferreola manticata</i> Pall.	Under Homonotinae Hpt., in survey of species (Italy)	Haupt (1933: 27)
1935	<i>Paraferreola</i> Sust.: <i>P. dentifer</i> Haupt, nov. spec. [nom. nudum], <i>P. manticata</i> Pall.; <i>P. manticata</i> f. <i>pici</i> Tourn.; <i>P. progressiva</i> Haupt	Under Homonotinae, in survey of species (Morocco and Western Algeria)	Nadig and Nadig (1935: 13)

Year	Name(s) used as valid	Notes	Reference
1935	<i>Paraferreola</i> Sustera, 1912: <i>P. melanostoma</i> Cam.; <i>P. distincta</i> Smith; <i>P. spilopus</i> Cam.; <i>P.</i> (subgen. <i>Eoferreola</i>) <i>soleana</i> Cam.	Under Psammocharinae in detailed revision of Pompilidae (Afrotropical)	Arnold (1935: 438–443)
1936	<i>Parraferreola</i> [sic]	Under Psammocharidae in discussion of natural selection	Robson and Richards (1936: 276, 278)
1936	<i>Paraferreola rhombica</i> Christ	Under Psammocharidae in faunistic ecological study (Lower Austria)	Roller (1936: 315, 317)
1937	<i>Paraferreola manticata</i> Pall.	In listing of pompilid specimens from Simontornya (Hungary)	Pillich (1937: 172)
1939	<i>Paraferreola</i>	Under Homonotinae in account of pompilid biology (Britain)	Richards and Hamm (1939: 54)
1941	<i>Paraferreola cyrenaica</i> sp. nov.	Under Pompilidae in survey of collection of aculeates (Libya)	Guiglia (1941: 173)
1944	<i>Paraferreola rhombica</i> Christ	Under Psammocharidae, Homonotinae in review of aculeate distribution (Czechia)	Šnoflák (1944: 145)
1949	<i>Paraferreola manticata</i> Pallas, 1771 emend. Šust. 1913 [sic].	Under Tribus Paraferreolini nov. (as “Typus”) in review of Pompilidae higher classification (World)	Haupt (1949: 65)
1950	<i>Paraferreola</i> Sust.: <i>Par. manticata</i> (Pall.); <i>Par. rhombica</i> (Christ)	Under Homonotinae Hpt. in notes on Pompilidae (Carpathian Basin)	Móczár (1950: 445)
1952	<i>Paraferreola manicata</i> [sic] <i>nigra</i> (Radoszkowski)	Under Psammocharidae in review of some species from western Tajikistan (Central Asia)	Gussakovskij (1952: 210–211)
1954	<i>Paraferreola rhombica</i>	In survey of nature in a national park (Poland)	Urbański (1954: 173)
1955	<i>Paraferreola anomala</i> Haupt MS [sic]	Under Psammoderini in review of Pompilidae (Egypt)	Priesner (1955: 185)
1956	<i>Paraferreola</i> Sust.: <i>P. manticata</i> Pall.; <i>P. rhombica</i> Christ	Under Pompilidae in review of fauna (Hungary)	Móczár (1956: 73)
1956	<i>Paraferreola Lichtensteini</i> Tourn.	Under Pompilidae in list of species (South France)	Morel, Nouvel and Ribaut (1956: 341)
1957	<i>Paraferreola Lichtensteini</i> Tourn.; <i>P. rhombica</i> Christ	Under Pompilidae in comparison of two species (South France)	Nouvel and Ribaut (1957: 566–567)
1958	<i>Paraferreola Lichtensteini</i> Tourn.	Under Pompilidae in list of species (South France)	Nouvel and Ribaut (1958: 20)
1959	<i>Paraferreola rhombica</i> Christ	Under Hymenoptera in treatment of new country records (Poland)	Noskiewicz (1959: 208)
1959	<i>Paraferreola rhombica</i> Christ	Considered as valid name for <i>Pompilus coccineus</i> Fabricius as used in 1878 report of biology	Kaston (1959: 110)
1960	<i>Paraferreola</i> Sustera, 1913 [sic]: <i>P. manticata</i> (Pallas); <i>P. rhombica</i> (Christ)	Under Pompilinae, tribe Paraferreolini in list of species (Italy)	Wolf (1960: 9)
1962	<i>Paraferreola</i> Šustera, 1913 [sic]: <i>P. simplex</i> sp. nov.; <i>P. grandis</i> Rad.; <i>P. caucasica</i> Rad.; <i>P. syraensis</i> Rad.; <i>P. anomala</i> sp. nov.; <i>P. manticata</i> Rad.; <i>P. rhombica</i> Christ; <i>P. erythraea</i> Pall.	Under Platyderinae Haupt, 1949 in taxonomic paper (Israel)	Haupt (1962: 65–69)
1965	<i>Paraferreola</i> : <i>P. syraensis</i> Radoszkowski; <i>P. rhombica</i> Christ; <i>P. rhombica thoracica</i> Rossi; <i>P. manticata</i> Pallas; <i>P. spec.</i>	Under Pompilinae in survey and taxonomic paper (Greece)	Priesner (1965: 64–65)
1966	<i>Paraferreola</i> Sustera: <i>P. anomala</i> Haupt; <i>P. manticata</i> Pall.; <i>P. grandis</i> Rad.; <i>P. claripennis</i> nov.; <i>P. facilis</i> nov.	Under Pompilinae, Psammoderini Arn. in taxonomic paper (Israel)	Priesner (1966a: 89, 145–147)
1983	<i>Paraferreola spec.</i>	Under Pompilidae in survey of aculeates (Krakatau, Indonesia)	Yamane (1983: 79)
1987	<i>Paraferreola</i> Sustera	Under Pompilinae, <i>Epipompilus</i> Kohl compared with nine other genera in review of fauna (New Zealand)	Harris (1987: 94)
1991	<i>Paraferreola melanostoma</i> (Cameron, 1904)	Under Pompilidae in annotated list of aculeates (South Africa)	Gess and Gess (1991: 81)
2005	<i>Paraferreola</i> : <i>P. dimidiata</i> Dahlbom; <i>P. formosanus</i> Babiy i.l.; <i>P. manicata</i> [sic] Pallas; <i>P. melanostoma</i> Cameron	In unevaluated list of pompilid specimens in museum (Germany)	Taeger (2005: 3)

Year	Name(s) used as valid	Notes	Reference
2019	<i>Paraferreola</i> : <i>P. curvifrons</i> (Cameron, 1910); <i>P. melanostoma</i> (Cameron, 1904); <i>P. soleana</i> Cameron, 1905; <i>P. spilopus</i> (Cameron, 1904)	Accepted names in catalogue of species (CoL, World)	Kroupa and Schmid-Egger (2019)
2021	<i>Paraferreola</i> Susterá 1913: <i>P. melanostoma</i> Cameron, 1904; <i>P. spilopus</i> Cameron, 1904; <i>P. soleana</i> Cameron, 1905	Under Pompilinae in list of species (Afrotropical)	van Noort (2021)

Conclusions and remedies – *Paraferreola*

It is evident that confusion about the applicability of *Paraferreola* in Pompilidae persists, with some authors still using it in that family. In contrast, *Paraferreola* has never been used as a valid name in Mutillidae. The initial misidentification of the type species is the primary reason for this confusion. Although Haupt (1927) attempted to rectify this, by designating the misidentified species (*Sphex rhombica* Christ, 1791) which had been accepted as that intended by Šusterá as the actual type species, such an action was not in accordance with the rules and practices of zoological nomenclature then applicable, hence Pate’s (1946) proposal of *Tea* as a new genus-group name with the designation of the same type species. This has not universally been accepted, however, and, additionally, there has been confusion about the relative status of *Eoferreola* and *Tea*, although synonymy of *Tea* with *Eoferreola* should have simplified matters. However, it is curious that the Catalogue of Life online listing of the species of *Eoferreola* (Bánki et al. 2021) does not include its type species (*Anoplius soleanus*), which is instead listed under *Paraferreola*, so that the species composition of *Eoferreola* is still questionable; the listing also does not include any mention of *Tea* as a genus, presumably because it is not considered valid, with several species of *Tea* all given as valid in *Eoferreola*. Additionally, *Eoferreola rhombica* is shown as a senior synonym of *Sphex ursus*.

The latest edition of the International Code of Zoological Nomenclature (ICZN 1999) provides a solution (Article 70.3.2), which now enables fixation of the species originally intended by Šusterá as the type of *Paraferreola*, something not provided for in previous editions, as follows.

***Paraferreola* Šusterá, 1912.** Verh. k. k. Zool.-Bot. Ges. Wien 62: 181 (in key), 200. Male, female.

Type species. *Sp[hex] rhombica* Christ, 1791 (misidentified as *Sphex ursus* Fabricius, 1793 by Šusterá 1912), by subsequent designation hereby under Article 70.3.2 of ICZN (1999), type locality Europe.

Gender. Feminine.

This accords with the usage intended by Šusterá (1912) and accepted by Haupt (1927) and Arnold (1935) in major revisionary works, amongst others. A comment is also needed on the date of publication of Šusterá’s work, since it has often been given as 1913. The paper was published in Volume 62 of the Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien, the last (10th) part of which

was only issued in February 1913, so that the volume as a whole was only completed in that year, hence the apparent assumption that the entire content only appeared in 1913. However, the various parts were published separately, and the date given in the volume itself for publication of Heft 5/6, containing pages (129) – (190) and 129–208, is 30th September 1912, and that for Heft 7, containing pages (191) – (206) and 209–256, is 25th October 1912. Šustera's paper spanned pages 171–213, so that all except the last four pages were published on 30th September 1912. (The dual numbering system apparently differentiated administrative matters, including reports from the various sections of the Academy (page numbers between parentheses) and the scientific papers themselves. The volume is available online at <https://www.biodiversitylibrary.org/item/47784#page/5/mode/1up>).

The implications of this action are the following: (1) *Tea* Pate, 1946 is an objective junior synonym of *Paraferreola* Šustera, 1912; (2) if Wahis's (1986) subjective synonymy of *Tea* with *Eoferreola* Arnold, 1935 is accepted, then *Eoferreola* also becomes a subjective junior synonym of *Paraferreola*.

Associated with the continuing confusion about the validity and application of *Paraferreola* in Pompilidae, is the fact that a pompilid family-group name has been based on *Paraferreola*, although it has seldom been used, and then essentially only by its original author. Paraferreolini was proposed by Haupt (1927: 262) as a new tribe in the subfamily Homonotinae Haupt, 1927 to include two genera: *Paraferreola* Šustera, 1912 and *Arachnotheutes* Haupt, 1927. Later, Haupt (1949) transferred this tribe to the subfamily Pompilinae. Haupt (1950) included in it the subtribes Anopliina, Batozonina and Episyronina, and even later (Haupt 1957) included the subtribe Platyderina. Haupt (1962, published posthumously) placed “Paraferreolini Haupt 1949” (including several genera) in the subfamily Pompilinae, but placed the genus “*Paraferreola* Šust. 1913” in the subfamily “Platyderinae Haupt 1949” together with the genus *Platyderes* Guérin-Ménéville, 1844; he keyed the females of eight species of *Paraferreola*, including two new ones. Zonstein and Wahis (2015) referred to Haupt's (1962) concept of Paraferreolini, but they did not comment on its validity. Later than Haupt's (1927) proposal of Paraferreolini, Arnold (1937) proposed the tribe Psammoderini for the genera *Psammoderes* Haupt, 1929 and *Paraferreola* Šustera, 1912, implying differences of opinion on the relationships of *Paraferreola*.

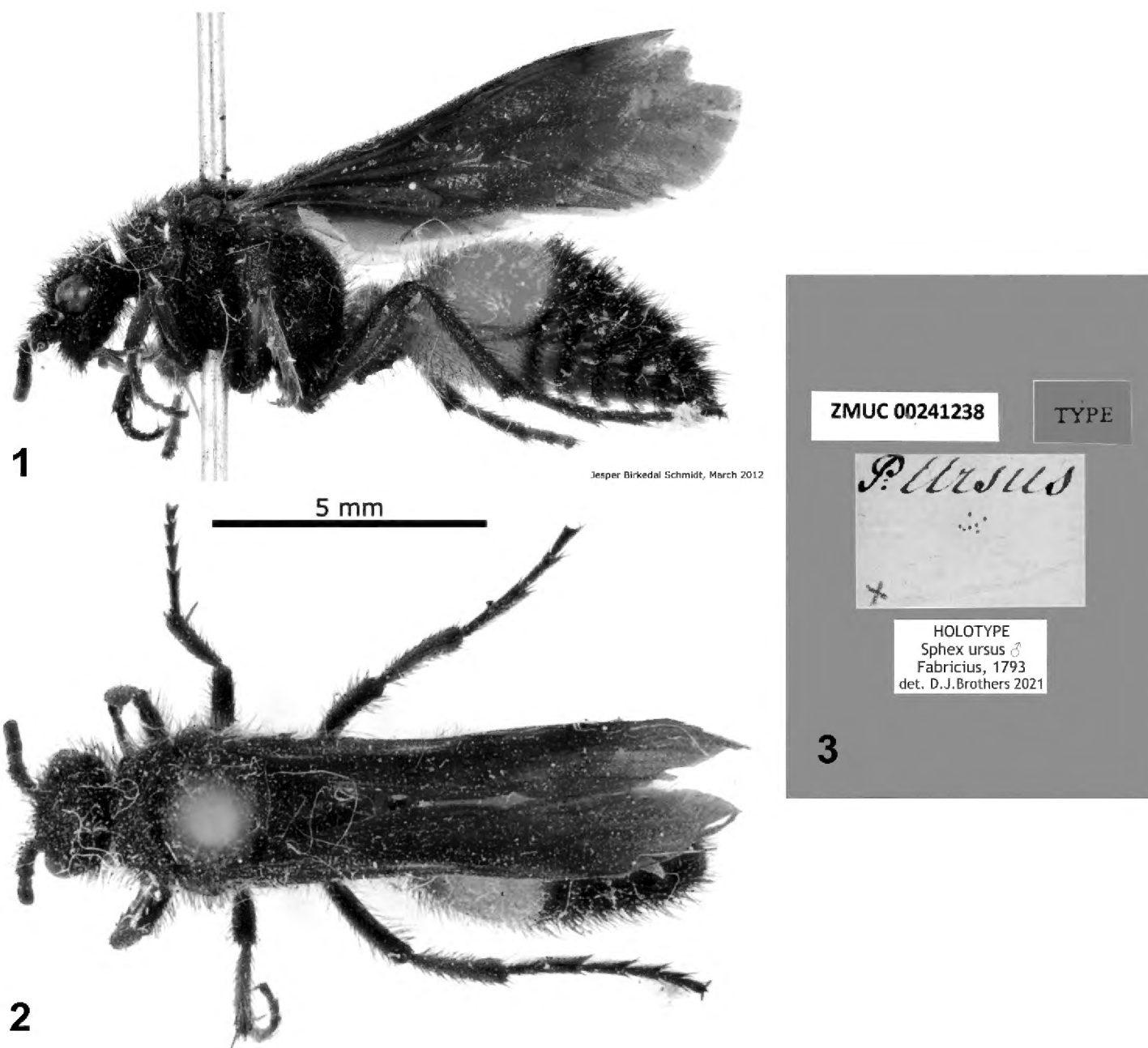
Conclusions and remedies – identity of *Sphex ursus* Fabricius, 1793

Previous ideas on the identity of *Sphex ursus* Fabricius, 1793 have been biased by an expectation that it is Palaearctic (although no locality information was provided in the original description), hence the suggestion of its being a *Myrmilla*. A single specimen (Figs 1–2) identified as “*Ursus*” is still housed in the Natural History Museum of Denmark, Copenhagen, Denmark, the depository of Tønder Lund's collection, as recorded by Zimsen (1964). Schulz (1912) noted that Fabricius's type specimens were easily identifiable by having small square green labels on the pins, and presumably found such a label on the Copenhagen specimen he considered to be the type. He also

noted that there were two specimens identified as *ursus* in Kiel (then the repository of Fabricius's own collection), but those presumably without the green labels. Although the Hymenoptera from Fabricius's collection have been transferred to Copenhagen on permanent loan, the additional specimens are not there (Lars Vilhelmsen, pers. comm.). The 'type' specimen now lacks a small green label but has a typeset red "TYPE" label (probably placed there by Zimsen). It has no locality label (according with the lack of locality information in the original description), but has an identification label ("P. Ursus"), handwritten but reflecting its subsequent placement in *Pompilus*, and with several pin holes indicating repeated removals and replacements; the handwriting is not that of Fabricius, who generally only gave the specific name and had untidier writing (Lars Vilhelmsen, pers. comm.), but this does not exclude it from being the specimen described by Fabricius, given the considerable amount of time that has passed since its description, and the fact that Fabricius's original labels had been discarded during reorganization of the collection (Zimsen 1964). Furthermore, Schulz (1912) provided a slightly fuller description than Fabricius had (see above), adding details about the colour and form of the first metasomal tergum and the integumental and setal colours of the second metasomal segment, and those agree fully with the 'type' specimen, giving confidence that this is the specimen which Schulz examined. Although Fabricius did not provide any information on the number of specimens he had seen, the fact that he specified Tønder Lund's collection as the only repository, and provided no locality information, suggests that a single specimen was involved. We thus consider that the specimen in Copenhagen is the holotype (Figs 1–2). It bears the labels as shown in Fig. 3.

Examination of photographs of the holotype (Figs 1–2) have shown that it is certainly conspecific with males of *Dasymutilla vesta* (Cresson, 1865), the most widely distributed species of *Dasymutilla* Ashmead, 1899 in North America, easily recognized by its smooth protruding subcircular eyes, short entirely punctate tegulae, narrowed campanulate tergum I, and general colour pattern (integument black except for ferruginous tergum II and sternum II, and setation entirely black except pale on tergum II), amongst other characters (Mickel 1928; Manley et al. 2020). The integumental coloration varies somewhat (as shown by figs 281 and 282 in Manley et al. 2020), and the type of *ursus* has the first tergum also ferruginous and much of the remainder of the integument appearing slightly faded to very dark brown rather than intensely black (perhaps a consequence of its age, though), so being more or less intermediate between the extremes illustrated there.

Although Mutillidae are of biological interest because of their habits and sexual dimorphism, they are of no economic importance, not often seen unless being searched for, and so seldom included in the literature except for specialist taxonomic works or reports of collection records. Although the species involved here is the most widespread species of *Dasymutilla* in North America, and the name *D. vesta* is thus applied to many specimens in collections, it is not in very widespread use in the literature, although it meets the conditions specified in Article 23.9.1.2 of the Code (ICZN 1999) for the maintenance of "prevailing usage" (apparently having been used as a valid name in about 30 works published over the last 50 years by at least 22 different authors). However, *ursus* Fabricius, 1793 has been used as a valid name since 1899, whether for a pompilid (Schulz 1906; Šustera 1912) or a mutillid (Nielsen 1907; Schulz 1912;



Figures 1–3. *Sphex ursus* Fabricius, 1793, holotype, ♂ **1** habitus, lateral view **2** habitus, dorsal view **3** labels.

Haupt 1927; Pate 1946; Arnold 1948) species, and therefore does not meet the requirement of Article 23.9.1.1. which would enable reversal of priority. The major consequence of this identification is that *Sphex ursus* Fabricius, 1793 must be recognized as a senior synonym of *Mutilla vesta* Cresson, 1865 and its junior synonyms, as follows, based on Manley et al. (2020), with corrections. (Note that the specific name “ursus”, a bear, is a Latin noun in apposition and therefore unchangeable in gender.)

***Dasymutilla ursus* (Fabricius, 1793), comb. nov.**

Sphex ursus Fabricius, 1793: 210; ♂

Mutilla Vesta (sic) Cresson, 1865: 436; ♀, syn. nov.

Scolia uncinata Provancher, 1882: 6; ♂, syn. nov.

Mutilla monozona Dalla Torre, 1897: 64 (new name for *Mutilla uncinata* (Provancher, 1882), not *Mutilla uncinata* Lucas, 1848), syn. nov.

Mutilla sappho Fox, 1899: 239; ♀, syn. nov.

Mutilla agenor Fox, 1899: 245; ♂, syn. nov.

Mutilla zella Rohwer, 1910: 50; ♀, syn. nov.

Pycnomutilla harmoniiformis Rohwer, 1912: 455; ♂, syn. nov.

- Dasymutilla errans* Rohwer, 1912: 457; ♀, syn. nov.
Dasymutilla bosquensis Rohwer, 1912: 457; ♀, syn. nov.
Dasymutilla ferrugatella Rohwer, 1912: 458; ♀, syn. nov.
Dasymutilla coloradella Rohwer, 1912: 458; ♀, syn. nov.
Dasymutilla coloradella virginica Rohwer, 1912: 459; ♀, syn. nov.
Dasymutilla coloradella kamloopsensis Rohwer, 1912: 459; ♀, syn. nov.
Dasymutilla texensis Rohwer, 1912: 460; ♀, syn. nov.
Dasymutilla mesillae Rohwer, 1912: 461; ♀, syn. nov.
Dasymutilla carolina Rohwer, 1912: 462; ♀, syn. nov.
Dasymutilla columbiana Mickel, 1928: 119; ♂, syn. nov.

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References

- André E (1899–1902) Species de Hyménoptères d'Europe & d'Algérie. Tome Huitième. Les Mutillides. Vve Dubosclard and A. Hermann (Paris), 480 pp. [i–x, 11–480, pls I–XV] <https://www.biodiversitylibrary.org/item/41019>
- Arnold G (1935) The Psammocharidae of the Ethiopian Region. Part IV. Annals of the Transvaal Museum 15(4): 413–483.
- Arnold G (1937) The Psammocharidae of the Ethiopian region. Part VII. Subfamily Psammocharinae continued. Annals of the Transvaal Museum 19(1): 1–98.
- Arnold G (1948) New species of African Hymenoptera No. 8. Occasional Papers of the National Museum of Southern Rhodesia 2(14): 213–250.
- Ashmead WH (1899) Superfamilies in the Hymenoptera and generic synopses of the families Thynnidae, Myrmosidae, and Mutillidae. Journal of the New York Entomological Society 7: 45–60. <https://www.biodiversitylibrary.org/item/36372#page/57>
- Bánki O, Roskov Y, Döring M, Ower G, Vandepitte L, Hobern D, Remsen D, Schalk P, DeWalt RE, Keping M, Miller J, Orrell T, Aalbu R, Adlard R, Adriaenssens E, Aedo C, Aescht E, Akkari N, Alonso-Zarazaga MA et al. (2021) Catalogue of Life Checklist (Version 2021-11-09). Catalogue of Life. [Accessed on 14.12.2021]
- Bingham CT (1897) Hymenoptera—Vol. I. Wasps and bees. In: Blanford WT (Ed.) The Fauna of British India, including Ceylon and Burma. Taylor and Francis (London), [i–xxx,] 579 pp. [pls I–IV] <https://www.biodiversitylibrary.org/item/180022>

- Brothers DJ, Lelej AS, Williams KA (2019) Genus-group names of Mutillidae (Hymenoptera): corrections and updates since 2008. *Zootaxa* 4651(3): 578–588. <https://doi.org/10.11646/zootaxa.4651.3.10>
- Cameron P (1905) On the Hymenoptera of the Albany Museum (Second Paper). *Records of the Albany Museum* 1(4): 185–244. <https://www.biodiversitylibrary.org/item/31254#page/211>
- Christ JL (1791) *Naturgeschichte, Klassifikation und Nomenclatur der Insekten vom Bienen, Wespen und Ameisengeschlecht; als der fünften Klasse fünfte Ordnung des Linneischen Natursystems von den Insekten: Hymenoptera. Mit häutigen Flügeln*. Hermannischen Buchhandlung (Frankfurt am Main), 535 pp. <https://doi.org/10.5962/bhl.title.87724>
- Cresson ET (1865) Fam. Mutillidae. In: *Catalogue of Hymenoptera in the collection of the Entomological Society of Philadelphia, from Colorado Territory*. *Proceedings of the Entomological Society of Philadelphia* 4: 428–442. <https://www.biodiversitylibrary.org/item/23927#page/448>
- Dalla Torre CG de (1897) *Catalogus Hymenopterorum hucusque Descriptorum Systematicus et Synonymicus. Volumen VIII: Fossores (Sphegidae)*. Guilelmi Engelmann (Lipsia [= Leipzig]): [1–4], [I–VIII,] 750 pp. <https://www.biodiversitylibrary.org/item/41193>
- Fabricius JC (1793) *Entomologia Systematica emendata et aucta, secundum Classes, Ordines, Genera, Species adjectis Synonymis, Locis, Observationibus, Descriptionibus*. T. 2. Christ. Gottl. Proft (Hafnia [= Copenhagen]), [I–VIII,] 520 pp. <https://doi.org/10.5962/bhl.title.125869>
- Fabricius JC (1798) *Supplementum Entomologiae Systematicae*. Proft et Storch (Hafnia [= Copenhagen]), [I–IV,] 572 pp. <https://www.biodiversitylibrary.org/item/219022>
- Fabricius JC (1804) *Systema Piezatorum secundum Ordines, Genera, Species adjectis Synonymis, Locis, Observationibus, Descriptionibus*. Carolum Reichard (Brunsviga [= Braunschweig]), [I–XIV, 15–440], 440 pp. [Index 1–30] <https://doi.org/10.5962/bhl.title.10490>
- Fox WJ (1899) The North American Mutillidae. *Transactions of the American Entomological Society* 25: 219–292. <https://www.biodiversitylibrary.org/item/32379#page/239>
- Gess FW, Gess SK (1991) A preliminary survey of the aculeate wasps and the bees of the lower reaches of the Nossob River Valley, Kalahari Gemsbok National Park, South Africa. *Koedoe* 34(2): 77–88. <https://doi.org/10.4102/koedoe.v34i2.424>
- Guérin-Méneville FÉ (1844) Neuvième Ordre – Hyménoptères [text]. In: *Iconographie du Règne Animal de G. Cuvier, ou représentation d'après Nature de l'une des espèces les plus remarquables et souvent non encore figurées, de chaque genre d'animaux. Avec un texte descriptif mis au courant de la science. Ouvrage pouvant servir d'atlas à tous les traités de zoologie*. Insectes. J.B. Bailliere (Paris): 398–466. <https://www.biodiversitylibrary.org/item/88601#page/404>
- Guiglia D (1941) Imenotteri aculeati raccolti in Libia da G. Krüger (Vespidae, Pompilidae). *Annali del Museo Civico di Storia Naturale Giacomo Doria* 61: 159–175. <https://www.biodiversitylibrary.org/item/109255#page/815>
- Gussakovskij VV (1952) Novye i maloizvestnye vidy Psammocharidae i Sphecidae (Hymenoptera) zapadnogo Tadzhikistana [New and little known species of Psammocharidae and Sphecidae of western Tajikistan]. *Trudy Zoologicheskogo Instituta Akademii Nauk SSSR* 10: 199–288. [In Russian]
- Harris AC (1987) Pompilidae (Insecta: Hymenoptera). *Fauna of New Zealand* 12: 1–160.

- Haupt H (1927) Monographie der Psammocharidae (Pompilidae) Mittel-, Nord- und Osteuropas. Deutsche Entomologische Zeitschrift, Beiheft "1926": 1–160; Beiheft 1927: 161–367. <https://doi.org/10.1002/mmnd.48019270401>
- Haupt H (1929) Weiterer Ausbau meines Systems der Psammocharidae. Mit Beschreibung neuer Gattungen und Arten. Mitteilungen aus dem Zoologischen Museum in Berlin 15(1): [i–ii,] 109–197.
- Haupt H (1933) Zur Kenntnis der Psammochariden-Fauna Italiens. Bollettino del Laboratorio di Entomologia del R. Istituto Superiore Agrario di Bologna 6: 25–27.
- Haupt H (1949) Das revidierte System der Pompilidae. Dichotomische Tabelle einer Hymenopterenfamilie. Beiträge zur Taxonomischen Zoologie 1: 63–76.
- Haupt H (1950) Pompilidae (Hymenoptera Sphecoidea). Exploration de Parc National Albert Mission G.F. de Witte (1933–1935) 69: 1–63.
- Haupt H (1957) Pompilidae (Hymenoptera Sphecoidea) II. Teil. Exploration de Parc National Albert Mission G.F. de Witte (1933–1935) 89: 1–39.
- Haupt H (1962) The Pompilidae of Israel. Bulletin of the Research Council of Israel 11B: 1–70.
- ICZN [International Commission on Zoological Nomenclature] (1999) International Code of Zoological Nomenclature. Fourth Edition. ITZN (London), [i–xxx,] 306 pp. <https://www.iczn.org/the-code/the-code-online/>
- Kaston BJ (1959) Notes on pompilid wasps that do not dig burrows to bury their spider prey. Bulletin of the Brooklyn Entomological Society 54: 103–113. <https://www.biodiversitylibrary.org/item/204925#page/451>
- Kinel J, Noskiewicz J (1930) Einige Bemerkungen über die zoogeographischen Verhältnisse von Podolien und Volhynien des polnischen Anteils. Polskie Pismo Entomologiczne 9(3–4): 272–288.
- Kroupa AS, Schmid-Egger C (2019) Hymenoptera Information System, Pompilidae of the World. In: Bánki O, Roskov Y, Döring M, Ower G, Vandepitte L, Hobern D, Remsen D, Schalk P, DeWalt RE, Keping M, Miller J, Orrell T, Aalbu R, Adlard R, Adriaenssens E, Aedo C, Aesch E, Akkari N, Alonso-Zarazaga MA et al. (Eds) Catalogue of Life Checklist (Version 2019-09). <https://doi.org/10.48580/d4sl-4kv> [Accessed on 14.12.2021]
- Latreille [PA] (1797) Précis des Caractères Génériques des Insectes, disposés dans un Ordre Naturel. Brive (Paris), [i–xvi,] 201 pp. [1–7] <https://doi.org/10.5962/bhl.title.58411>
- Lelej AS, Brothers DJ (2008) The genus-group names of Mutillidae (Hymenoptera) and their type species, with a new genus, new name, new synonymies, new combinations and lectotypifications. Zootaxa 1889: 1–79. <https://doi.org/10.11646/zootaxa.1889.1.1>
- Lepeletier de Saint-Fargeau A (1845) Histoire Naturelle des Insectes. Hyménoptères. Tome Troisième. Roret (Paris), [i–iv,] 646 pp. <https://www.biodiversitylibrary.org/item/286450>
- Linnaeus C (1758) Systema Naturae per Regna Tria Naturae, secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis. Tomus I. Editio Decima Reformata. Laurentii Salvii (Holmia [= Stockholm]), [i–iv,] 824 pp. <https://doi.org/10.5962/bhl.title.542>
- Lucas H (1847–1849 ["1849"]) Cinquième Ordre. Les Hyménoptères. In: Exploration Scientifique de l'Algérie pendant les Années 1840, 1841, 1842 publiée par Ordre du Gouvernement et avec le Concours d'une Commission Académique. Sciences Physiques. Zoologie. III. Troisième Partie. Insectes (suite). Arthus-Bertrand (Paris): 141–344, pls Hyménoptères 1–19.

- Manley DG, Williams KA, Pitts JP (2020) Keys to Nearctic velvet ants of the genus *Dasymutilla* Ashmead (Hymenoptera: Mutillidae), with notes on taxonomic changes since Krombein (1979). *Proceedings of the Entomological Society of Washington* 122(2): 335–414. <https://doi.org/10.4289/0013-8797.122.2.335>
- Mickel CE (1928) Biological and taxonomic investigations on the mutillid wasps. United States National Museum, Bulletin 143: 1–351. [pl. 1–5] <https://doi.org/10.5479/si.03629236.143.1>
- Móczár L (1950) Notes on the pompilids species in the Carpathian Basin (Hym.). Eighth International Congress of Entomology, Proceedings (Stockholm), 438–446.
- Móczár L (1956) Pókölödarázs alkatúak Pompiloidea. *Fauna Hungariae*, 11. Akadémiai Kiadó (Budapest), [i–ii,] 1–76 pp. [Index 1–3]
- Morel A, Nouvel H, Ribaut H (1956) Les Hyménoptères vespiformes de la plaine littorale du département des Pyrénées-orientales. *Bulletin de la Société d'Histoire naturelle de Toulouse* 91(3–4): 335–344.
- Motschulsky V (1860) Catalogue des insectes rapportés des environs du fl. Amour, depuis la Schilka jusqu'à Nikolaëvsk, examinés et énumérés. *Bulletin de la Société Impériale des Naturalistes de Moscou* 32(4): 487–507. <https://www.biodiversitylibrary.org/item/107037#page/499>
- Nadig AD, Nadig AD (1935) Beitrag zur Kenntnis der Hymenopterenfauna von Marokko und Westalgerien. Zweiter Teil: Scoliidae, Tiphiidae, Mutillidae, Psammocharidae, Chrysididae. *Jahresbericht der Naturforschenden Gesellschaft Graubündens* 73: 1–20.
- Nielsen JC (1907) Gravehvpse og Gedehamse. *Danmarks Fauna* 2, [i–ii,] 86 pp. <https://www.biodiversitylibrary.org/item/16043>
- Noskiewicz J (1959) Nowe dla fauny Polski gatunki błonkówek (Hymenoptera) i muchówek (Diptera) i nowe stanowiska gatunków rzadko obserwowanych. *Polskie Pismo Entomologiczne* 29 (14): 201–214.
- Nouvel H, Ribaut H (1957 [“1956”]) Sur deux espèces d'hyménoptères de la région de Banyuls: un Pompilide peu connu et une espèce nouvelle d'Odynère. *Vie et Milieu* 7(4): 566–568.
- Nouvel H, Ribaut H (1958) Hyménoptères Vespiformes des environs de Banyuls-sur-Mer. *Faune terrestre et d'eau douce des Pyrénées-Orientales, fascicule 1*: 1–32.
- Pagliano G (2008) Elenco mondiale dei generi di Hymenoptera con specie tipo. *Museo Regionale di Scienze Naturali, Monografie XLIII* (Torino), 465 pp.
- Pagliano G, Brothers DJ, Cambra R, Lelej AS, Lo Cascio P, Matteini Palmerini M, Scaramozzino PL, Williams KA, Romano M (2020) Checklist of names in Mutillidae (Hymenoptera), with illustrations of selected species. *Bollettino del Museo Regionale di Scienze Naturali di Torino* 36(1–2): 5–427.
- Pate VSL (1946) The generic names of the spider wasps (Psammocharidae olim Pompilidae) and their type species. *Transactions of the American Entomological Society* 72: 65–137.
- Pillich F (1937) Die Psammocharidenfauna Simontornyas (Hym.). *Entomologisches Jahrbuch* 1937: 169–172.
- Priesner H (1955) A review of the Pompilidae of Egypt (Hymenoptera). *Bulletin de la Société entomologique d'Égypte* 39: 1–215.
- Priesner H (1965) Zur Kenntnis der Pompiliden Griechenlands. *Sitzungsberichte der Österreichische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse* 174: 55–78. https://doi.org/10.1007/978-3-662-24642-9_1

- Priesner H (1966a) On some Pompilidae of Israel. Israel Journal of Entomology 1: 89–154. <http://ijentomology.online/ojs/public/journals/1/archives/IJE-1966-Priesner-OCR.pdf>
- Priesner H (1966b) Studien zur Taxonomie und Faunistik der Pompiliden österreichs. Teil I. Naturkundliches Jahrbuch der Stadt Linz 1966: 187–208. https://www.zobodat.at/pdf/NKJB_12_0187-0208.pdf
- Priesner H (1967) Zur Kenntnis der Pompiliden (Hymenoptera) der Türkei. Sitzungsberichte der Österreichische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse 176: 45–60. https://doi.org/10.1007/978-3-662-24641-2_1
- Priesner H (1968) Studien zur Taxonomie und Faunistik der Pompiliden Österreichs. Naturkundliches Jahrbuch der Stadt Linz 14: 125–209. https://www.zobodat.at/pdf/NKJB_14_0125-0209.pdf
- Priesner H (1973) Neue Pompiliden aus der Türkei (Hym.) Nachrichtenblatt der Bayerischen Entomologen 22(6): 106–110. <https://www.biodiversitylibrary.org/item/92002#page/116>
- Provancher L (1882) Faune canadienne (Continué de la page 362 du vol. XII.). Le Naturaliste Canadien 13: 4–15. <https://www.biodiversitylibrary.org/item/51438#page/14>
- Richards OW, Hamm AH (1939) The biology of the British Pompilidae (Hymenoptera). Transactions of the Society for British Entomology 6(4): 51–114. <https://www.biodiversitylibrary.org/item/254326#page/3>
- Robson GC, Richards OW (1936) The Variation of Animals in Nature. Longmans, Green & Co. (London), [i–xvi,] 425 pp. [2 pl.] <https://www.biodiversitylibrary.org/item/23480>
- Rohwer SA (1910) Some new wasps from New Jersey. Proceedings of the Entomological Society of Washington 12(1): 49–52. <https://www.biodiversitylibrary.org/item/20247#page/71>
- Rohwer SA (1912) Descriptions of new species of wasps in the collections of the United States National Museum. Proceedings of the United States National Museum 41: 447–478. <https://www.biodiversitylibrary.org/item/94484#page/547>
- Roller H (1936) Faunistisch-ökologische Studien an den Lösswänden der Südosthänge des Bisamberges. Zeitschrift für Morphologie und Ökologie der Tiere 31(2): 294–327. <https://doi.org/10.1007/BF00445155>
- Schmiedeknecht O (1930) XXXIV. Fam. Psammocharidae (Pompilidae). In: Die Hymenopteren Nord-und Mitteleuropas mit Einschluss von England, Südschweiz, Südtirol und Ungarn, nach ihren Gattungen und zum grossen Teil auch nach ihren Arten analytisch bearbeitet, Zweite, gänzlich umgearbeitete Auflage. Gustav Fischer (Jena), 594–627.
- Schulz WA (1906) Strandgut. In: Spolia Hymenopterologica. Junfermannschen Buchhandlung (Paderborn), 76–269. <https://doi.org/10.5962/bhl.title.59757>
- Schulz WA (1912) Aelteste und alte Hymenopteren skandinavischer Autoren. Berliner Entomologische Zeitschrift 57(1): 52–102. <https://doi.org/10.1002/mmnd.19120570109>
- Šnoflák J (1944) Rozšíření některých Aculeat (Apidae a Vespoidea) na mohelnské hadcové stepi. Archiv Svazu na Ochranu Přírody a Domoviny na Moravě 6(5): 133–155.
- Šustera O (1912) Die paläarktischen Gattungen der Familie Psammocharidae (olim Pompilidae, Hym.). Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien 62(5/6): 171–213. <https://www.biodiversitylibrary.org/item/47784#page/419>
- Šustera O (1922) Familie Psammocharidae (Pompilidae). In: Maidl F, Beiträge zur Hymenopterenfauna Dalmatiens, Montenegros und Albaniens. I. Teil: Aculeata und Ghrysididae

- [sic]. Annalen des Naturhistorischen Museums in Wien 35: 55–65. <https://www.biodiversitylibrary.org/item/27931#page/61>
- Taeger A (2005) Hymenoptera Collection of the DEI – Pompilidae. Leibniz-Zentrum für Agrarlandschafts- und Landnutzungsforschung (ZALF) e.V., Deutsches Entomologisches Institut (DEI) (Müncheberg): 1–5. [Posted from 2005 to about 2009 on ZALF website which no longer exists, teste A Taeger, Nov. 2020]
- Urbański J (1954) Przyroda Wielkopolskiego Parku Narodowego. Przegląd Zachodni 1954(1–2): 164–180.
- van Noort S (2021) Classification of Pompilinae (Pompilidae) In: WaspWeb: Hymenoptera of the Afrotropical region. <http://www.waspweb.org/Vespoidea/Pompilidae/Pompilinae/Classification/index.htm> [Accessed on 19.12.2021]
- Wahis R (1963) Hyménoptères Pompilides de Yougoslavie (Hymenoptera: Pompilidae). Fragmenta Balcanica 4: 191–196.
- Wahis R (1970) Nouvelle contribution à la connaissance des Hyménoptères Pompilides de la Yougoslavie (Hymenoptera: Pompilidae). Bulletin des Recherches Agronomiques de Gembloux (N.S.) 5(3–4): 710–744.
- Wahis R (1986) Catalogue systematique et codage des Hymenopteres Pompilides de la region ouest-europeenne. Notes fauniques de Gembloux 12: 1–91.
- Wesmael M (1851) Revue critique des Hyménoptères fouisseurs de Belgique. Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique 18(2): 362–384, 451–493. <https://www.biodiversitylibrary.org/item/20618#page/384> [and] <https://www.biodiversitylibrary.org/item/20618#page/475>
- Wolf H (1960) Pompiliden aus der Sammlung A. Giordani-Soika (Hym. Pompiloidea). Bollettino del Museo Civico di Storia Naturale di Venezia 13: 7–19.
- Wolf H (1965) Systematisches Verzeichnis der Wegwespen (Hym. Pompiloidea) Mittel- und Nordeuropas. Nachrichten des Naturwissenschaftlichen Museums der Stadt Aschaffenburg 72: 1–38. https://www.zobodat.at/pdf/Nachr-naturw-Mus-Aschaffenburg_72_1965_0001-0038.pdf
- Wolf H (1970) Wegwespen aus dem Museo Civico di Storia Naturale in Mailand (Hymenoptera Pompiloidea). Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale in Milano 110(4): 391–417. <https://www.biodiversitylibrary.org/item/266595#page/95>
- Wolf H, Móczár L (1972) Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei. 287. Pompilidae Gattungen: *Cryptocheilus* bis *Arachnospila* (Hymenoptera). Acta Zoologica Academiae Scientiarum Hungaricae 18(1–2): 237–265.
- Yamane S (1983) The Aculeate Fauna of the Krakatau Islands (Insecta, Hymenoptera). Reports of the Faculty of Science, Kagoshima University (Earth Science & Biology) 16: 75–107.
- Zimsen E (1964) The Type Material of I.C. Fabricius. Munksgaard, Copenhagen, 656 pp. <https://archive.org/details/typematerialofic0000zims>
- Zonstein I, Wahis R (2015) Revision of the Palearctic genus *Gonaporus* Ashmead, 1902 of spider wasps (Hymenoptera: Pompilidae). Zootaxa 4018(4): 451–505. <https://doi.org/10.11646/zootaxa.4018.4.1>